

Relationship Between Physical Workload, Work Fatigue, and Drinking Water Consumption to Work Productivity of Brickmakers

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ABSTRACT

Background: Work productivity is the ability of the workforce to produce several goods per unit of time. Several factors, such as physical workload, work fatigue, and drinking water consumption, can cause high or low levels of work productivity. **Method:** This research was conducted in a brick-making business in Kaligayam Village, Tegal Regency, in August 2022 using an analytic observational research method and a cross-sectional approach. The sample in the study consisted of 42 workers and was analyzed using the Chi-Square Test with a confidence level of 95%. The instruments in this study were questionnaires to determine drinking water consumption and work productivity, as well as a physical workload measurement tool, namely the oximeter, and a work fatigue measurement tool, namely the reaction timer. **Results:** The physical workload (OR= 0.133; CI= 0.032-0.563; $p < 0.05$), work fatigue (OR = 0.195; CI = 0.042-0.914; $p < 0.05$), drinking water consumption (OR = 11.250; CI = 2.100-60.267; $p < 0.05$) had a relationship to work productivity. **Conclusion:** There is a relationship between the variables of physical workload, work fatigue, and drinking water consumption on the work productivity of brickmakers. Elderly workers should do work with a light workload, workers can rest for 30 minutes every 4 hours of work, make the most of their rest time, and there is a need for workers' self-awareness to consume fluids according to NIOSH rules with a total of ≥ 6 liters per day.



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Introduction

Economic development in the formal and informal sectors is a component of the preparation of the national economy [1]. Based on data from the Central Statistics Agency or *Badan Pusat Statistik* (BPS), the total workforce in August 2021 was 140.15 million, and the total working population was 131.05 million. The Indonesian workforce is dominated by workers in the informal sector, as many as 77.91 million people (59.45%) [2]. Along with industrial growth, workers who become activists in national development, especially in the industrial sector, are needed as vital elements that control raw materials, tools, machines, production processes, and other procedures in the workplace. On average, the informal sector has a higher productivity level than the formal sector due to its flexibility, making it easier to reach the informal labor market [3].

Work productivity is the total production of goods made by workers in units of goods duration per day [4]. A high level of worker productivity can produce the maximum production and vice versa. If workers can produce goods quickly and according to the target, then these workers can be said to be productive [5]. In the workplace, workers certainly experience pressure from surrounding conditions such as physical workload, work fatigue, the amount of drinking water consumption, and a hot work environment which affects work productivity [6]. Excessive heat in the worker's body will be released through the process of evaporation from the skin. The amount of lost water must be replaced with drinking water intake according to the body's needs. If there is an imbalance between the amount of drinking water that is less than the water excreted by the body, it is referred to as dehydration [7].

One of the informal sector businesses is a brick-making business which is the livelihood of some residents of Kaligayam Tegal Village. The procedure for making bricks in Kaligayam Village is still carried out using manual techniques using human power with the process of making bricks consisting of mixing, molding, scaling, chopping, and burning. Based on a preliminary study of the hot working climate felt by the craftsmen coming from direct sunlight, this is because the workplace is open and outdoors with an ambient temperature of 30°C - 35°C. Meanwhile, when burning bricks, the ambient temperature can reach >120°C. Some artisans use Asian conical hats, cloth hats, and shirts tied around their heads to reduce direct sun exposure. The working period of workers varies from 20 years to 40 years. Brickmakers work an average of 8 hours and rest for 1 hour. Brickmakers usually prepare a supply of drinking water from home, but the consumption of drinking water by the craftsmen is not sufficient and regular. 9 out of 10 workers consume <7 liters of drinking water while working. The average work productivity in 1 day can make several 1000-2000 bricks. Of the ten workers interviewed, 100% of workers complained of fatigue. 20% of workers aged 33-50 sometimes complain of mild joint pain and aches in the back, arms, and legs. 80% of workers aged 51-60 years and over often experience dizziness, joint pain, numb hands, and aches in the back, hands, knees, and soles of the feet because most work is done in a squatting position when making bricks. Therefore, the authors aim to analyze the relationship between physical workload, work fatigue, and drinking water consumption on the work productivity of brickmakers in Tegal.

Materials and Method

This research is included in the quantitative research using observational analytic methods and using a cross-sectional approach. This research was carried out in August 2022 with a population of brickmakers in Kaligayam Village, Tegal Regency. Samples were taken using a total sampling technique of 42 brickmakers. The independent variables in this study are physical workload, work fatigue, and drinking water consumption, while the dependent variable is work productivity. The physical workload was measured using an Oximeter, and work fatigue was measured using a Reaction Timer. In contrast, drinking water consumption and work productivity used a questionnaire to determine how much drinking water was consumed per day and the number of bricks produced in 1 day. Data analysis in this study used univariate and bivariate analysis with the Chi-Square statistical test. This research was declared to have passed ethical approval by the health research ethics commission with No: 331/EA/KEPK-FKM/2022, which was issued on August 25, 2022.

Results and Discussion

Results

Table 1 shows that the physical workload on brick-making workers receives a more light physical workload of as many as 28 workers, with a percentage of 66.7%. In the measurement of work fatigue, it is known that 32 brick-making workers experience mild work fatigue with a percentage of 76.2%. There are more workers with low drinking water consumption, namely 25 workers with a percentage of 59.5%. A total of 25 workers, with a percentage of 59.5%, have a productivity level in the high category.

Table 1. Univariate Analysis Results

Variable	Total	%
Physical Workload		
Heavy	14	33.3
Light	28	66.7
Work Fatigue		
High	10	23.8
Mild	32	76.2
Drinking water consumption		
High	17	40.5
Low	25	59.5
Work Productivity		
High	25	59.5
Low	17	40.5

Based on Table 2, the statistical test obtained from the Chi-Square test results on physical workload, work fatigue, and drinking water consumption obtained a p-value <0.05. It means that the variables of physical workload, work fatigue, and consumption of drinking water influence work productivity.

Table 2. Results of Bivariate Analysis

Variables	Work Productivity		P	OR (CI 95%)
	Low	High		
Physical Workload				
Light	7 (25%)	21 (75%)	0.004	0.133 (0.032-0.563)
Heavy	10 (71.4%)	4 (28.6%)		
Work Fatigue				
Mild	10 (31.3%)	22 (68.8%)	0.029	0.195 (0.042-0.914)
High	7 (70%)	3 (30%)		
Drinking Water Consumption				
Low	15 (60%)	10 (40%)	0.002	11.250 (2.100-60.267)
High	2 (11.8%)	15 (88.2%)		

Discussion

The workload is an effort that needs to be done to complete the task demands of work activities. Workload needs attention from all workplaces because it is one of several things that can affect worker productivity [8]. The physical workload is a workload that requires the physical strength of a person's muscles to be a source of stamina and a benchmark in determining the weight or lightness of a job. Physical exertion significantly affects job performance, where humans control their work [9]. Workers must accept the workload according to their ability to work. A workload that is too heavy can cause excessive fatigue, interfere with worker health and frustration, and can reduce muscle performance to contract and relax. This results in muscle fatigue and can cause decreased work productivity [10].

Based on the measurement of physical workload using the Oximeter tool, the results showed that 28 workers (66.7%) made bricks with a light physical workload, and 14 workers (33.3%) received a heavy physical workload. Based on the Chi-Square statistical test results, it was stated that out of 42 workers with low productivity, most were obtained from workers with a heavy physical workload of 71.4%, and workers with high productivity were mostly obtained from workers with a light physical workload of 75%. The Chi-Square statistical test results stated that the p-value = 0.004, where <0.05. It means that H_0 is rejected, and it can be concluded that there is a relationship between physical workload and work productivity. The results of this study are following previous studies where there is a significant relationship between physical workload and work productivity at the Gama Karanganyar Cigarette Company, with a value of $p= 0.029$ and a value of $r= -0.341$ [11]. The results of other related studies have also been carried out at PT Adhi Karya (Persero) Tbk, obtained a p-value of 0.045 which is smaller with a value of $\alpha= 0.05$ ($p < 0.05$), so it can be

concluded that there is a significant relationship between physical workload and worker productivity [12].

The work performed by brickmakers consists of mixing, molding, scaling, chopping, and burning with the body bending, squatting, and lifting bricks which are done for a long time and repeatedly. The physical workload can be affected by age, work activity, work and rest time, health conditions, and work environment. The light workload is dominated by molding and scaling workers in a sitting and squatting position, while medium and heavy workloads are dominated by mixing clay while standing and bending. Several factors can cause workers with heavy physical workloads and low productivity. As we get older, the ability to function organs of the body will decrease so that workers feel tired more quickly, which results in decreased work productivity [13]. There are several workers with fewer than 8 hours working because the brick-making process is carried out after school, causing additional workload on workers and less than optimal productivity. Workers can increase work productivity even though the physical workload they receive is increasing, and this is because workers increase their work capacity continuously. Meanwhile, workers with decreasing work productivity produce results that could be more optimal because these workers do not increase work capacity even though the physical workload received is increasing [11]. Because workers work every day, it will potentially become a heavy physical workload one day. Brickmakers should carry out work with an appropriate workload based on the ability and capacity of the body. Older workers should do work with a light workload.

Work fatigue is a condition in which a person's efficiency and endurance when working decreases [14]. Work fatigue can describe the body's activity towards the activities being carried out, and the exposure workers receive while working. Work fatigue is a factor closely related to decreased work performance, concentration, and productivity. Apart from that, work fatigue for a long time can increase the risk of work accidents and Occupational Diseases [15]. The fatigue felt by the workforce can be seen from the decreased morale resulting in monotonous work activities, the work assigned being too large, the pressure for fast work time, the shape of the body when working which is not ergonomic, the nutritional level of workers who are not typical, the psychological state of workers, age, dietary settings and the duration of a person's proficiency in carrying out his work [16].

Work fatigue has been measured for brick-making workers in Kaligayam Village using a Reaction Timer with a light sensor, and the measurement results are divided into mild and high categories. The results obtained were 32 people (76.2%) in the mild category of work fatigue and ten people (23.8%) in the high category of work fatigue. The Chi-Square statistical test found that more workers had mild fatigue with high productivity, namely 68.8%, while workers with high fatigue with high productivity, namely 30%. The Chi-Square statistical test results stated that the p -value = 0.029, where <0.05 . This proves that H_0 is rejected, and it can be concluded that there is a relationship between work fatigue and work productivity. The results of this study are following previous studies by obtaining a p -value of 0.001 ($p < 0.05$) where work fatigue and work productivity in the weaving workforce is interrelated. Obtained a close relationship between work fatigue and work productivity. If the level of labor productivity is disrupted by physical or psychological fatigue, this will affect decreased work productivity [17]. The results of other studies that are in line have also been carried out at the Port of Bitung. The results of testing between work fatigue and work productivity in loading and unloading workers have a relationship with a p -value of 0.019 [18].

Work fatigue can be seen in the body's response based on the work done [19]. Work fatigue experienced by brickmakers results from work activities carried out manually and for a long time coupled with a hot work environment. With working time >8 hours in 1 day, the worker's body is prone to feeling tired. Workers dominate mild work fatigue with light workloads due to low cardiovascular loads, so workers don't feel tired quickly [20]. Another factor that affects mild work fatigue is the acclimatization process, where workers are used to working in a hot environment, which can affect work fatigue [21]. Meanwhile, high work fatigue is influenced by age, type of work, health conditions, and environment. Older workers will experience a decrease in performance, so they feel tired more quickly [22]. Workers exposed to heat daily do a lot of physical work, don't drink much more quickly, and are at risk of becoming dehydrated, causing workers to tire quickly [23]. Workers who experience high work fatigue with high productivity can be caused by working hard to

pursue brick production to match the target, impacting the level of worker fatigue. Work productivity that is not on target can be caused by workers who feel tired and affect work productivity. The reduced stamina of workers will affect their concentration and focus, which will impact worker productivity [24]. Because workers work every day, they will have the potential to become overworked one day. To reduce the level of fatigue, workers can take a 30-minute break every 4 hours of work and make the most of their rest time, and there is a need for self-awareness among brickmakers to consume fluids according to NIOSH rules with a total of ≥ 6 liters per day [25].

Water is an essential element for cooling the body in hot situations, especially for workers who produce a lot of sweat from exposure to a hot work environment [26]. Drinking water regularly can prevent dehydration after the body is exposed to heat, sweating, and urinating. Good water consumption is derived from water that is ingested and obtained as a result of metabolism from food excreted from the body, such as water excreted through urine, water in feces, and water produced from the skin and lungs [27].

Measurement of drinking water consumption for brickmakers was carried out using questionnaires and interviews. The results obtained were that 25 workers (59.5%) consumed < 6 liters of drinking water, and 17 workers (40.5%) consumed ≥ 6 liters of drinking water. The drinking water quantity guidelines refer to NIOSH rules where the recommended drinking water consumption is 250 ml every 15-20 minutes. Workers who work ≥ 8 hours must consume at least ≥ 6 liters of fluids [25]. Based on the results of statistical testing, the Chi-Square Test found that more workers consumed high drinking water with high productivity, namely 88.2%, while workers consumed low drinking water with high productivity, namely as much as 40%. The Chi-Square statistical test results show a p-value = 0.002 which is < 0.05 . This shows that H_0 is rejected and it can be concluded that there is a relationship between drinking water consumption and work productivity. The results of this study agree with research on blacksmith workers in Kudus. This study obtained a $p = 0.021$ ($p < 0.05$), which means there is a relationship between fluid consumption and the degree of dehydration [28]. The results from other related studies that have also been carried out at PT Candi Mekar Pernalang show that there is a relationship between drinking water consumption at work and dehydration with a p-value of 0.001 ($p < 0.05$) [27].

Based on the results of the study, several factors affect low drinking water consumption, such as dislike of plain water, preferring to drink tea, coffee, or other sweet drinks, not wanting to urinate repeatedly, and workers' assumptions that water is felt to provide less energy to do work. Workers are more concerned with producing bricks under the target, thus overriding thirst. The body needs water consumption because it has various roles needed by the body, such as a transport medium, forming fluids and cells in the body, regulating body temperature, and as a solvent [29]. Approximately 80% of the body's needs are fluids, including water, with the rest coming from food [30]. The hydration needs of each individual are determined by many factors such as age, nutritional status, type of work, and work environment. The body sweats and releases water while breathing, urinating, and defecating. Loss of bodily fluids requires replacement so that the role of body fluids is not disrupted and prevents dehydration [28]. Dehydration can affect mood and morale and reduce concentration and work capacity due to fatigue. This leads to lower work productivity, increased risk of injury, and occupational diseases. Workers must maintain safety and health, as well as the level of productivity of workers, to be able to complete work as well as possible so that the company will get maximum profit. Workers with sufficient hydration are the most effective way to control their productivity and body health when they are active in a hot environment [31]. Business owners can provide workers with additional drinking water so that drinking water needs are met.

Conclusion

This study concludes that there is a significant relationship between physical workload, work fatigue, and consumption of drinking water on work productivity in brickmakers in Kaligayam Village, Tegal Regency. Suggestions for workers are that older workers are advised to take jobs with light physical workloads, such as scaling or molding bricks, make the most of their rest time by being in the shade, and replenish energy through eating or drinking. Suggestions for business owners can

provide small chairs that can be used in the scaling process to reduce fatigue and provide additional drinking water so that the worker's fluid needs, with a total of 6 liters, can be met.

Declaration

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